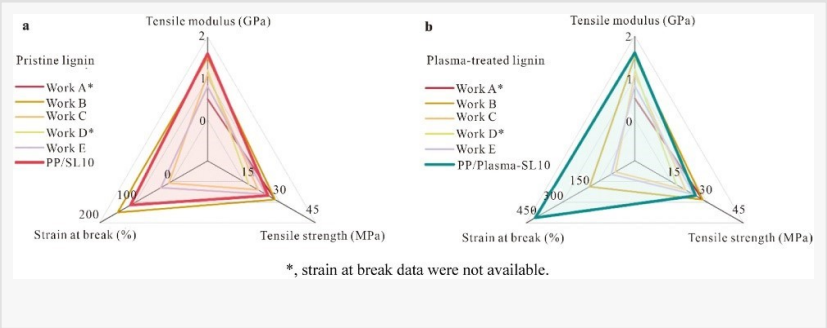
Plasma Treatment Enhances Polypropylene-Lignin Blends

A Sustainable Approach to Improving Polymer Performance



NANJING, CHINA, February 26, 2025 /EINPresswire.com/ -- This study explores the use of plasma treatment to improve the compatibility and performance of polypropylene-lignin blends, resulting in enhanced mechanical properties and reprocessability.

Polypropylene (PP) is one of the most widely used polymers globally, known for its low cost, versatility, and excellent mechanical properties. However, the increasing production and improper disposal of PP contribute to significant environmental concerns. To address this, researchers have turned to lignin, a natural aromatic polymer and byproduct of the pulping industry, to create biobased composites that reduce the carbon footprint of traditional polyolefin products.

The study, titled "Enhanced Performance and Reprocessability in Polypropylene-Lignin Blends Through Plasma Treatment," investigates a new compatibilization strategy for PP-lignin blends. The researchers used a gliding-arc-tornado (GAT) reactor to treat soda lignin in an argon atmosphere, resulting in significant chemical-structural modifications. The treated lignin exhibited increased concentrations of phenoxy radicals and reduced hydroxyl functionalities, leading to enhanced compatibility with PP.

The researchers prepared PP-lignin blends incorporating 5%, 10%, and 20% of either pristine or plasma-treated lignin by melt-blending in a twin-screw extruder. Detailed investigations of the thermo-mechanical and rheological properties revealed that blends with plasma-treated lignin showed greater thermo-oxidative stability, improved viscoelastic response, and significantly enhanced mechanical performance. For instance, the strain at break for PP containing 10% plasma-treated lignin increased by 294%.

The study also demonstrated the enhanced reprocessability of the blends, with over 95% retention of yield strength and strain at break after re-extrusion. This finding highlights the

potential for sustainable and eco-friendly practices in the polymer industry, reducing the environmental impact of plastic waste.
In conclusion, the research provides the first demonstration of the effectiveness of plasma treatment as a viable and sustainable strategy to improve filler-matrix interactions in PP-lignin blends. This method paves the way for the development of lignin-based thermoplastic polyolefin materials with enhanced thermo-mechanical characteristics and improved reprocessability, aligning with global efforts to reduce plastic waste and promote sustainability.

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